

**REMARKS**

Claims 1-8 are currently pending.

**I. The Rejections Under 35 U.S.C. §103(a)**

Claims 1, 3 and 7 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over JP 2002-025611 A (JP '611) in view of U.S. Patent No. 6,632,572 (Takahashi) and either JP 2002-298909 (JP '909), JP 2002-110229 (JP' 229) or JP 2002-050398 (JP '398).

Claim 2 is rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over JP '611 in view of Takahashi and either JP '909, JP '229 or JP '398, and further in view of U.S. Patent No. 6,818,351 (Sunagawa).

Claims 4, 6 and 8 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over JP '611 in view of Takahashi, JP '398 and either JP '909 or JP '229.

Claim 5 is rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over JP '611 in view of Takahashi, JP '398 and either JP '909 or JP '229, and further in view of U.S. Patent Sunagawa.

Applicants respectfully submit that the present invention is not rendered obvious over the disclosures of the cited art and request that the Examiner reconsider and withdraw these rejections in view of the following remarks.

The Examiner asserts as follows:

The differences between claims 1 and 7 and JP '611 are that JP '611 does not teach of the casing structure and explosion-proof valve or of the electrolyte further including a phenylcycloalkane compound, or an alkylbenzene compound

having a quaternary carbon directly bonded to a benzene ring (claim 1), of the phenylcycloalkane compound is at least one selected from the group consisting of phenylcyclohexane, phenylcyclophetane, and phenylcyclopentane; and the alkylbenzene compound is at least one selected from the group consisting of tert-butylbenzene, tert-amylbenzene, and tert-hexylbenzene (claim 7).

Takahashi discloses that the same claimed casing and explosion proof valve is known in the art (abstract and Figs. 1 and 2). The motivation for using this structure in a lithium battery is to improve the battery safety. Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '611 by employing the casing structure and explosion-proof valve of Takahashi since it would have improved the battery safety.

Applicants respectfully traverse the Examiner's assertions for the following reasons.

JP '611 recites a non-aqueous electrolyte secondary battery containing ethylene sulfite and vinylene carbonate. Therefore combining Takahashi and JP '611 as suggested by the Examiner would result in a secondary battery employing the casing structure and explosion-proof valve of Takahashi and a non-aqueous electrolyte containing ethylene sulfite and vinylene carbonate.

The battery resulting from the combination provides a coating film formed on the electrode surface by reaction of the ethylene sulfite and vinylene carbonate, which has the goal of

inhibiting the further decomposition of the electrolytic solution. However, this coating film cannot sufficiently inhibit the decomposition of the electrolytic solution when the battery is repeatedly charged and discharged at temperatures (40-60°C) in the vicinity of the upper temperature limit for normal use. Thus, the solvent is decomposed and the internal pressure is increased. The increased pressure actuates the explosion-proof valve, which means the end of the battery life. See Applicants' specification, page 2, lines 14-16, page 3, lines 9-10, lines 17-25, and page 4, lines 11-16. An object of the present invention is to provide a non-aqueous electrolyte secondary battery that is superior in reliability (high-temperature standing resistance) under a high temperature condition (100°C). A battery that ends its life by actuating the explosion-proof valve when used in temperatures of 40-60°C would not have been able to attain the object of the present invention.

Thus, the secondary battery obtained by the combination of Takahashi and JP '611 is exactly the type with the problem that is solved by the present invention. The present invention provides a non-aqueous electrolyte secondary cell that is excellent in cycle characteristics (high temperature cycle characteristics) at around the upper limit (40 to 60°C) of normal use temperature of a cell, and is excellent in reliability (high temperature standing resistance) after left standing under a high temperature (approximately 100°C). (See Applicants' specification, page 4, lines 11-16). Thus, a main objective of the present invention is to eliminate unnecessary actuation of the explosion-proof valve and thus increase the battery life. This cannot be attained by the combination of Takahashi and JP '611.

The Examiner further asserts as follows:

With respect to the electrolyte further including a phenylcycloalkane compound, or an alkylbenzene compound having a quaternary carbon directly bonded to a benzene ring:

Each of JP '909 and JP '229 discloses adding tert-alkylbenzene compounds to a lithium battery nonaqueous electrolyte (abstract as applied to claims 1 and A). The motivation for adding this compound to the nonaqueous electrolyte is that it improves the cycling and discharge capacity of the electrochemical cell. Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of JP '611 by adding tert-alkylbenzene compounds to a lithium battery nonaqueous electrolyte as taught by either JP '909 or JP '229 since it would have improved the cycling and discharge capacity of the electrochemical cell. JP '398 discloses adding phenylcyclohexane to a lithium battery nonaqueous electrolyte (abstract as applied to claims 1 and 7).

Although JP '909, JP '229 and JP '398 describe improving cycle characteristics and discharge characteristics, a teaching of the prevention of unnecessary actuation of the explosion-proof valve (current shut-off valve) is nowhere found in the references. Therefore, there is no motivation for combining these references in order to prevent unnecessary actuation of the explosion-proof valve. The Examiner argues for obviousness to modify JP '611. However,

when different additives are mixed, side effects often occur which adversely affect reactions inside the battery. Even though each additive may be separately effective, one skilled in the art would not consider the mixture of the additives would be effective or to guarantee the desired result. One of ordinary skill would not have combined all the solvents recited in the references unless there is some teaching to do so.

X1 shown in Table 1 of Applicants' specification is a cell with vinylene carbonate and ethylene sulfite added in the electrolytic solution, and X2 is a cell with phenylcyclohexane used instead of ethylene sulfite. X1 and X2 are inferior in cycle characteristics capacity maintenance rate and high temperature standing resistance. B4 shown in Table 4 is a cell with phenylcyclohexane in addition to vinylene carbonate and ethylene sulfite, and B6 is a cell with phenylcyclohexane and tert-amylbenzene in addition to vinylene carbonate and ethylene sulfite. The cycle characteristics capacity maintenance rates of these cells are 66% and 69%, respectively, which are significantly poor compared with other cells. Thus, it is preferable that the total added amount of phenylcyclohexane and tert-amylbenzene is restricted to 0.2 to 3.0 parts by mass. That is, combination of the solvents recited in the references does not improve the cycle characteristics and discharge characteristics of the electrochemical cell. Thus, one of ordinary skill would not have used in JP '611 three of the four materials recited in JP '909, JP '229, JP '398 when there is no motivation to do so (at the risk of compromising the cycle characteristics capacity maintenance rate).

To the contrary of the results achieved by the comparative examples representative of the

cited art, by the use of Applicants' claimed non-aqueous electrolyte secondary cell, unexpectedly high temperature cycle characteristics are obtained and reliability (such that an internal pressure rise cuts off current but solution leakage does not occur) are achieved. See the comparative data of Applicants' specification.

Further to the rejection based on Sunagawa, one of the objectives of the present invention is to prevent a decrease in cycle characteristics (load characteristics) when the bulk density is increased, since an increase in the bulk density of the positive electrode active material causes a decrease in high temperature cycle characteristics.

Sunagawa, Fig. 3, shows that it is possible that the load characteristics are better when the bulk density is  $3.3 \text{ g/cm}^3$  or more than when the bulk density is less than  $3.0 \text{ g/cm}^3$ . However, this teaching cannot be relied to establish a *prima facie* case of obviousness of Applicants' claims for the following reasons.

Although Sunagawa, Figure 3, shows that it is possible that the load characteristics are better when the bulk density is  $3.3 \text{ g/cm}^3$  or more than when the bulk density is less than  $3.0 \text{ g/cm}^3$ , Figure 3 also shows that in the long run, increasing the bulk density beyond  $3.0 \text{ g/cm}^3$  gradually deteriorates the load characteristics. This teaching implies that increasing the bulk density poses a problem of decreased load characteristics. To solve the problem, Sunagawa proposes that in a positive electrode composed of a mixture of spinel manganese oxide and lithium cobalt oxide, with the particle diameters and bulk densities of the two materials are set within specified ranges. To the contrary, the present invention suggests mixing three kinds of

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materials and adding the mixture in the non-aqueous electrolytic solution.

Sunagawa does not teach adding in the non-aqueous electrolytic solution a mixture of the claimed materials. Therefore it would not have been obvious for one of ordinary skill in the art to combine the teachings of Sunagawa, which specifies the average particle diameter of the active material, with JP '611, which teaches a technique totally different from that of Sunagawa, and further to combine this combination with JP '909, JP '229, or JP '398 in order to use three of the particular materials. Thus, Applicants' respectfully submit that claim 2 is non-obvious over Sunagawa.

For the above reasons, it is respectfully submitted that the subject matter of claims 1-8 is neither taught by nor made obvious from the disclosures of JP '611 in view of Takahashi and either JP '909, JP '229 or JP '398 (or further in view of Sunagawa) and it is requested that the rejections under 35 U.S.C. §103(a) be reconsidered and withdrawn.

## **II. Conclusion**

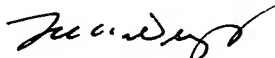
In view of the above, Applicants respectfully submit that their claimed invention is allowable and ask that the rejections under 35 U.S.C. §103 be reconsidered and withdrawn. Applicants respectfully submit that this case is in condition for allowance and allowance is respectfully solicited.

If any points remain at issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the local exchange number listed below.

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If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,  
**WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP**



Lee C. Wright  
Attorney for Applicants  
Registration No. 41,441  
Telephone: (202) 822-1100  
Facsimile: (202) 822-1111

LCW/af